Expansion of Cash Transfer for the Elder and Elderly Suicide Rates*

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Abstract

This study examines the causal impact of expanding the elderly welfare expenditure in South Korea on the elderly suicide rate, utilizing changes in the Basic Pension system as an instrumental variable. We find that an increase in welfare expenditure significantly lowers suicide rate among those 65+, especially in men over 80. Lastly, our analysis of elderly households' income and consumption indicates that while total income remained stable, consumption rose following enhanced public income transfers. This implies that stronger public income transfer programs reduce income uncertainty, boost consumption and leisure, and consequently lower the suicide rate.

JEL Classification: H31, H51, I14

Keywords: Welfare Expenditure, Basic Pension, Suicide Rates, Elderly Population

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1 Introduction

As of 2019, the suicide rate among elderly (aged 65 and older) in South Korea stood at 46.6 per 100,000 people, significantly exceeding the OECD average of 17.2 (Ministry of Health and Welfare and Korea Foundation for Suicide Prevention, 2022). On the other hand, South Korea's current income level appears to be at a moderate level within the OECD countries.[1] Although a country's economic prosperity doesn't solely determine its suicide rate, it is closely related to various factors such as social safety nets, government expenditure, human capital, and health status. Considering this, it appears challenging to understand why the elderly suicide rate in South Korea is highest among OECD countries especially when taking into account the country's current economic status.

The fact that South Korea has achieved rapid economic growth can be crucial for understanding the high elderly suicide rate. While the economic level has improved rapidly, the social insurance, including pensions, has not expanded at the same pace. In the past, however, the inability of the elders to accumulate sufficient assets for their post-retirement life was not a significant issue because the responsibility for elderly care rested with their adult children in many Asian countries. However, due to factors such as rapid industrialization, urbanization, and low birth rates, the number of nuclear families had increased significantly, and the responsibility for elderly care is increasingly shifting to the elderly themselves. Older individuals who have not been able to accumulate sufficient assets by the time of retirement are more likely to become part of the elderly poverty group. The presence of this elderly poverty group may be one of the contributing factors to South Korea's high elderly suicide rate. In such circumstances, public transfer (or welfare expenditure) for the elderly, particularly those with unfavorable economic conditions, may have a positive impact on reducing

[1]The OECD survey results indicated that South Korea's average wage level was USD 48,921.93 as of 2022, which is similar to the surveyed 35-country average of USD 49,792.06.

suicide rates.

In Figure 1, we illustrate the suicide rates per 100,000 people by three age groups (dashed line), and the per capita welfare expenditure for the elderly (solid line) annually from 2012 to 2020.[2] Notably, while the welfare expenditure for the elderly increased approximately 2.6 times (from 121,000 KRW to 311,000 KRW), the elderly suicide rates for the three age groups (60-69, 70-79, 80 and older) declined.

In this paper, we investigate whether the elderly welfare expenditure presented in Figure 1 have a causal relationship with elderly suicide rate. The previous literature has focused on the health effects of public transfers (welfare expenditure in general) in advanced countries where social safety net is well established (Crossley and Zilio, 2018; Evans and Garthwaite, 2014; Milligan and Stabile, 2011). However, in environments like South Korea, where the social safety net is not fully developed, and the elderly poverty rate is high, the effects of welfare expenditure on health can differ significantly from the impact in countries with well-established welfare systems. Therefore, our study is expected to broaden the understanding of the impact of government welfare expenditure in health based on a situation where several factors related to elderly suicide rates differ significantly from previous research.

As previously introduced, the relationship between per capita welfare expenditure and suicide rates in Figure 1 appears to be clear enough to interpret as a causal relationship. However, this figure reflects a mix of various possible relationships that could exist between the two variables. For instance, there is a possibility that suicide rates gradually decreased as younger cohorts, who have better financial preparations for their later years over the

[2]Unless otherwise specified, "welfare expenditure" refers to the elderly and youth welfare expenditure in South Korea's local finance. Ideally, it would be preferable to separate the elderly welfare expenditure, but there are limitations in separating the elderly and youth expenditure from the local finance database. As observed in Gangnam District (2022), the elderly welfare expenditure(1.174 billion KRW) accounted for an absolute majority of the total elderly and youth welfare expenditure (1.263 billion KRW) Therefore, even if the elderly and youth welfare budget is used as a proxy for the elderly welfare budget, it is not expected to pose significant issues.

past decade, entered the elderly generation. Therefore, interpreting the observed correlation between the two variables in time series data as causal is challenging.

To enable causal analysis, we employed two empirical strategies. First, we leveraged spatial variation in elderly welfare expenditure at the local government level (*si/gun/gu*, hearafter municipality). Because macro factors, such as changes in cohorts of elderly generations, typically affect all local governments, it is possible to control for the impact of these macro factors and isolate the causal impact of welfare expenditure on suicide rates by utilizing regional variations in welfare expenditure and suicide rates.

Second, we construct a simulated instrumental variable (IV) and use it as an instrument for elderly welfare expenditure. Because the level of welfare expenditure for the elderly in each municipality can be endogenously determined, neglecting endogeneity in the welfare expenditure can lead to biased results. In particular, negative economic shocks that affect specific regions may simultaneously trigger changes in suicide rates and welfare expenditures. To mitigate this concern, a simulated IV is constructed by utilizing the predicted values of welfare expenditure for the elder resulting from the Basic Old-Age Pension (BOAP) and Basic Pension (BP) system reforms, which make up a significant portion of the welfare expenditure.[3] The reforms of the Basic Pension systems regarding changes in the amount of public transfer allocated to elderly households were determined by the central government and applied uniformly to all municipalities, making them exogenously determined, regardless of regional economic or social conditions. Furthermore, by using this IV, additional endogenous changes in the welfare expenditure by local governments, such as the reduction of local government welfare programs in response to the expansion of the Basic Pension System, can be adequately controlled.

[3]During the analysis period from 2013 to 2019, the Basic Old-Age Pension System was expanded into the Basic Pension System in 2014. Hereafter, we use the term "Basic Pension" which refers both the Basic Old-Age Pension and the Basic Pension for consistency.

Based on our IV estimation results, we arrive at the following conclusions. First, the predicted value of elderly welfare expenditure based on changes in the Basic Pension expenditure appears to have had a significant impact on the growth of welfare expenditure for each local government during the analysis period.[4] Specifically, the estimated coefficient for the predicted value of elderly welfare expenditure is 1.27, indicating that for every 1 million KRW increase in the predicted elderly welfare expenditure, the actual elderly welfare expenditure at the local government increased by 1.27 million KRW.[5]

Second, we find evidence that the increase in elderly welfare expenditure at the local government was found to be significant to reduce the suicide rate among elders. Specifically, municipalities where the elderly welfare expenditure increased by 1 million KRW during the analysis period exhibited a decrease in the suicide rate by 38.37 per 100,000 elders compared to municipalities where the elderly welfare expenditure did not increase. When comparing regions with the lowest 25% with the highest 75% in terms of the changes in elderly welfare expenditure, the difference in the increase in elderly welfare expenditure was approximately 625,000 KRW. This means that, compared to regions in the lowest 25%, regions in the highest 75% experienced an additional reduction of 23.98 suicides per 100,000 elders.

Next, we estimate heterogeneous treatment effects by gender, age, educational attainment, and household composition. When performing heterogeneity analysis by gender, we find some evidence that most of the observed reduction in suicide rates are attributable to a reduction effect in the elderly male population. The treatment effect in the elderly female population appeared relatively smaller and statistically insignificant. Furthermore, in the heterogeneity analysis across different age groups, we observe that the treatment effect is

[4]Hereafter, unless otherwise mentioned, we use the term "elderly welfare expenditure" to refer "per capita" expenditure, which means the total welfare expenditure divided by the population of individuals aged 65 and over.

[5]Based on the 2023 exchange rate, 1 million KRW is equivalent to 748.21 US dollars.

particularly pronounced among elders aged 80 and above. The elders aged 80 and older are likely to have lower levels of human capital accumulation, asset accumulation, and post-retirement income security, compared to younger age groups. Considering this, it is possible that the treatment effect is more pronounced among the elderly individuals with liquidity constraints. For educational level and household composition, the treatment effects are heterogeneous only in the case of household composition. An increase in elderly welfare spending results in a significant reduction in suicide rates for single-person households, unlike in larger households where the effect is minimal and statistically insignificant.

To shed light on the mechanism through which the increase in elderly welfare expenditure reduces the suicide rate, we then examine the effects of increased welfare expenditure for the elderly on the income and consumption of elderly households. Since the most significant institutional change that contributed to the increase in elderly welfare expenditure was the 2014 Basic Pension reform, we estimated the effects of the 2014 reform on the income and consumption of elderly households.

Using a difference-in-differences analysis with the 55-64 age group as the control group and the 65 and older age group as the treatment group, the estimated results show that the 2014 reform increased the public transfer income for treated households. However, the treated households responded by reducing their labor income. Consequently, the total income for the treated household was estimated to remain unchanged. In the case of consumption, it is noteworthy that even though the total income of treated elderly households did not increase, their consumption increased after the 2014 reform. Despite the absence of an increase in annual income, the rise in consumption among treated households can be attributed to the reinforcement of the legally mandated Basic Pension system, which guaranteed a permanent income increase, consequently leading to increased consumption and leisure activities. These estimated results suggest a potential mechanism for how the increase in elderly welfare

expenditure led to a reduction in suicide rates.

The results and methods in our paper contribute to three distinct literatures. First, we provide new estimates of the fiscal expenditure effects on suicide using exogenous variations by leveraging institutional changes in the Basic Pension system. Prior works in this area has predominantly reported results where expansionary (austerity) fiscal policies are associated with a decrease (increase) in suicide rates (Matsubayashi et al., 2020; Toffolutti and Suhrcke, 2019; Antonakakis and Collins, 2015; Minoiu and Andres, 2008; Fishback et al., 2007). Most of these studies employ the fixed-effects at the regional (or national) level to control the unobservable time-invariant characteristics. However, it is expected that fiscal expenditures in specific regions would be highly correlated with the economic conditions of those regions, and economic conditions can influence suicide rates (Ruhm 2000). For instance, in economically distressed area, the local government may consider implementing austerity fiscal policies. Given the negative correlation between macroeconomic conditions and suicide rates, the impact of fiscal expenditure could be overestimated.

Second, there has been a growing body of research that examines the health effect of welfare programs designed for income redistribution (Wilson and McDaid, 2021; Crossley and Zilio, 2018; Evans and Garthwaite, 2014; Milligan and Stabile, 2011; Balan-Cohen, 2008). In relation to this literature, there are studies in health economics that explore the causal relationship between income (assets) and the health gradient. These studies aim to elucidate the causal relationship between income and health, using exogenous shocks such as the reunification of East and West Germany (Frijters et al., 2005) or winning the lottery (Cesarini et al., 2016; Kim and Koh, 2021). In relation to this literature, our paper present new evidence regarding the effects of welfare programs aimed at increasing income for the elders in countries where social welfare systems are not well-established and the elderly poverty rate is high.[6]

[6]Figure A1 presents the relative poverty rate (below 50% of median income) among elders (aged 66

Kim and Koh (2021) also examined Singapore which is a country with an underdeveloped social safety net. However, as noted by Evans and Garthwaite (2014), estimations relying on unusual circumstances like lottery winnings may have lower external validity. In contrast, the Basic Pension system used in our study universally increases income for all elderly individuals with an income below 70% of the total income distribution, providing more meaningful evidence in terms of external validity.

Finally, there are several studies that examine the impact of the Basic Pension system reforms in South Korea. For example, previous studies have investigated the effects of the 2014 Basic Pension system reform on depression among elders (Pak, 2021), its influence on the consumption of the elders (Kang et al., 2022), and its consequences on private income transfers from adult children through the 2008 reform (Koh and Yang, 2021). We use the Basic Pension reforms to construct an IV for elderly welfare expenditure, ultimately aiming to estimate the effect of increased elderly welfare expenditure on suicide rate. Furthermore, we explored the impact of the 2014 reform on the consumption and income of elderly households. Our analysis revealed that despite no discernible increase in total income, elderly households did increase their consumption and leisure.

The rest of this paper is organized as follows. Section 2 provides an overview of the trends in elderly suicide rates in South Korea and relevant policies. In Section 3, we explain the primary data sources and sample construction. In Section 4 and 5 we present the empirical strategy to estimate the causal effect of increasing elderly welfare expenditure on elderly suicide rate, and discuss our main results. Section 6 concludes.

and above) for OECD countries as of 2013. South Korea's elderly poverty rate stands at 47.7%, which is significantly higher when compared to the OECD's average poverty rate of 12.35%.

2 Background

2.1 Elderly Suicide Rates

South Korea's elderly suicide rate is notably higher than other age groups. Moreover, when benchmarked against other nations, it is alarmingly high. Figure 2 presents the age-specific suicide rates in South Korea for the year 2020, indicating a common pattern of rising suicide rates with increasing age groups. From the 40s to the 60s, both men and women have a suicide rate ranged from 40 to 45 per 100,000 population. However, in the 70s, the rate sharply increases to 64.5 for men, and in the 80s, it rises to 118 for men and 35.2 for women. This pattern reveals a substantial increase in suicide rates with increasing age.

Another salient observation from Figure 2 is the pronounced gender disparity in suicide rates, especially post the age of 30. The divergence widens with age, resulting in a 2.8 times difference in the 60s, 3.6 times differences in the 70s, and 3.4 times differences in the 80s and older. While factors such as diminished social roles upon retirement from primary employment, social isolation, adverse income shocks might explain this gender variance in elderly suicide rates, it is essential to consider that male suicide rates are higher than female rates in all age groups other than the elderly, suggesting the existence of additional factors beyond these influences.

Interestingly, the pattern of rising suicide rates with age is not universal. In 2020, the elderly suicide rate (for those aged 65 and above) in the United States was lower than that in the 45-54 and 25-34 age groups.[7] Similarly, Japan's elderly suicide rate doesn't significantly deviate from the rates of those in their late twenties and older.[8] Consequently, South Korea

[7]We use the information compiled by the Suicide Prevention Resource Center, based on data from the Centers for Disease Control and Prevention in the United States (`https://www.sprc.org/scope/age`, accessed on December 19, 2022).

[8]The information regarding Japan's suicide rate was referenced from the graph presented in the following article (Donga Science, "82-Year-Old Kim Ji-Young' More Hardship Than the 51-Year-Old Mother Generation," `https://www.dongascience.com/news.php?idx=29581`, accessed on December 19, 2022).

may face a more acute need for policy intervention concerning elderly suicides than other nations. The severity of South Korea's elderly suicide rate can also be confirmed through comparisons with other countries. When compared to major OECD member countries depicted in Figure 3, as of 2019, South Korea's elderly suicide rate is significantly higher at 46.6 per 100,000 individuals, surpassing the comparison with other countries and greatly exceeding the OECD average of 17.2.

On the other hand, when examining trends over time, the elderly suicide rates in South Korea has been consistently decreasing. Figure 1 elucidates that individuals aged 60 and above have witnessed a descending trend in suicide rates. For instance, the rate for the 60-69 age group plummeted from 42.4 in 2012 to 30.1 in 2020. Similarly, the rates for the 70-79 and 80+ brackets have also seen significant drops during the same period.[9]

If the reduction in suicide rates in South Korea is attributed to either a relative surge in elderly welfare expenditure or enhanced income levels compared to other nations, a more distinct downward trend can be observed. Figure 3 tracks changes in suicide rates among individuals aged 65 and above in South Korea versus selected OECD member countries from 2013 to 2020. While the comparison might be restricted by the selective nature of countries in the figure, it's clear that the suicide rates for the selected countries have generally remained stable. In contrast, South Korea's suicide rate has steadily decreased from 2013 to 2020. In summary, South Korea has made commendable progress in curbing elderly suicide rates but they still remain at higher levels compared to other countries.

[9]On the other hand, during the same period, suicide rates for those aged 20-29, 30-39, 40-49, and 50-59 showed little change, with rates moving from 19.5 to 21.7, 27.3 to 27.1, 30.9 to 29.2, and 35.3 to 30.5, respectively.

2.2 Elderly Poverty Rate and the Basic Pension System

Figure A1 presents the relative poverty rate (below 50% of median income) for the population aged 66 and over in OECD countries as of 2013. The elderly poverty rate in South Korea is notably high at 47.7%, in stark contrast to the OECD's average poverty rate of 12.35%. Considering that Costa Rica, the second-highest, has a poverty rate of 24.3%, it becomes evident that South Korea's relative poverty rate among the elderly is significantly elevated, both in relative and absolute terms. It's important to note that relative poverty rates have limited relevance to the minimum income required to sustain life and do not account for an individual's accumulated assets. Nevertheless, Figure A1 underscores the rising concern of elderly poverty in South Korea.

The Basic Pension system is a program closely associated with elderly poverty. Introduced in 2008, the Basic Pension system was established in response to the pressing issue of elderly poverty. Its primary objective is to provide a stable income for the elderly, thereby supporting their financial well-being in later life. Before the Basic Pension system, the Kyoung-ro Pension system served a similar purpose. This system provides a fixed amount (ranging from a minimum of 15,000 KRW to 50,000 KRW per month) to elderly individuals with an income below the 15th percentile of the income distribution.

The Basic Pension system introduced in 2008, replaced the Kyoung-ro Pension system (1998-2007) and was expanded to be a more comprehensive income security system for the elderly. it provides income support to 70% of elderly individuals aged 65 and above.[10] Since its introduction in 2008, single-person households received a monthly benefit of 84,000 KRW. In 2014, this system was renamed the Basic Pension (previous name was the Basic Old-Age Pension), and it underwent reforms in terms of benefit amount. The Basic Pension system

[10]From January to June 2008, it covered 60% of those aged 70 and above, while from July to December 2008, it encompassed 60% of those aged 65 and above. Since 2009, the coverage extends to 70% of those aged 65 and above.

started offering a monthly benefit of 200,000 KRW for single-person households in 2014. The benefit amount has since been adjusted regularly and the program is still in operation to this day.

The Basic Pension system is the most substantial shift in elderly welfare programs from 2013 to 2019. Over this period, the per capita welfare expenditure for the elderly increased by approximately 1.54 million KRW on average across 221 municipalities, while the total Basic Pension expenditure in South Korea surged from 3.2 trillion KRW in 2013 to 14.7 trillion KRW in 2019 (Yoon, 2021). When the total expenditure of the Basic Pension in 2013 and 2019 is recalculated as per capita budgets using information about the population aged 65 and over, the per capita BP expenditure increased by approximately 1.38 million KRW (from 0.536 million KRW to 1.919 million KRW). This indicates that the increase in the welfare expenditure during this period can be largely attributed to the expansion of the Basic Pension budget.[11]

Finally, Table 1 presents changes in the Basic Pension's monthly average payment amount for single-person households. Table 1 indicates that significant adjustments to the standard benefit amount of the Basic Pension were primarily made in 2014, 2018, and 2021. In other years, adjustments were made slightly to account for inflation rates.

3 The Data

3.1 Data Sources

To examine the effect of elderly welfare expenditure on suicide rates, we incorporate various variables constructed from multiple data sources. First, we use Cause of Death Statistics

[11]The financial expenditure by local governments for the Basic Pension program includes subsidies from the central government. Yoon (2021) provides the ratio of central government funding in the total Basic Pension expenditure from 2014 to 2019, known as the national subsidy rate. The average national subsidy rate for 2014 and 2019 was around 76.8%.

(CDS) from Statistics Korea to construct suicide rates by elderly age groups at the municipal level (dependent variable). The CDS is a dataset derived from death certificates to understand the causes of death among Koreans, including information on the deceased's cause of death, gender, address, educational level, and more. This dataset provides information on intentional self-harm, which is a code that indicates suicide. Using this information, we aggregate the number of deaths at the municipal level. We combine data on the number of suicide deaths with population data by age group and municipality, obtained from the Ministry of the Interior and Safety(MOIS)'s resident registration population statistics.[12] This allowed us to create the final variable for suicide rates per 100,000 population at the municipal level. In the analysis of heterogeneous effects, we also employ Korean Census data. Since the population data from the MOIS' statistics does not offer disaggregated information regarding educational level and household composition, we create a substitute dataset by leveraging sample weights provided in the Census data.

Next, we construct the elderly and youth welfare expenditure using data from the Local Finance 365 website, which provides expenditure data at the municipal level. While it is not possible to precisely separate elderly and youth welfare expenditure, as mentioned earlier, the elderly welfare expenditure constitutes a significant portion of the combined elderly and youth welfare expenditure. Therefore, we utilized this variable as a proxy for the elderly welfare expenditure at the municipal level.

To construct the instrumental variables, we rely on the 2012 municipal-level data regarding Basic Pension recipients, as documented in the Ministry of Health and Welfare (2013). Since 2012 predates our analysis period, we used this municipal-level data as the foundation to create the instrumental variables, which we will discuss later in this article. It is worth

[12]The resident registration population statistics is available on the Korea National Statistical Office's portal website (`https://kosis.kr/index/index.do`)

noting that if historical data on Basic Pension recipients preceding 2012 become available, it would be possible to create instrumental variables from an earlier period. However, as far as we are aware, the 2012 data is the earliest available information at the municipal level.[13]

The other control variables, including the share of Basic Livelihood Security Program recipients are derived from the Ministry of Health and Welfare (2013). The variables related to employment figures, the ratio of self-employed among employees, and the proportion of workers in the manufacturing sector are obtained from the Census of Establishments from Statistics Korea. Other factors, such as population statistics, voter turnout, divorce rates, the number of nursing homes and medical facilities at the municipal level are sourced from the Korea National Statistical Office.

Lastly, to understand the mechanism through which observed increases in welfare expenditure at the municipal level affect the reduction in suicide rates, we analyze the impact of the 2014 Basic Pension benefit increase on the income and consumption of elderly individuals aged 65 and over. For this analysis, we used data from the Survey of Household Finances and Living Conditions (SHFLC) provided by Statistics Korea. The SHFLC, offered by Statistics Korea, gleans information on household assets, debts, income, and expenditures by surveying 20,000 households across the nation.

3.2 Descriptive Statistics

To examine the impact of the increase in elderly welfare expenditure between 2013 and 2019 on the reduction of municipal-level elderly suicide rates, we construct data with the following restrictions. First, we excluded the data from regions where municipal boundaries

[13]Even if we obtain recipient information for the years 2008 to 2012, we cannot analyze the effect of the Basic Pension introduction in 2008 on the elderly suicide rate. Our identification strategy relies on using past information to predict the number of potential recipients, and 2008 is the year of its introduction. Therefore, to analyze the effects of the 2008 Basic Pension introduction, we would need information on the income distribution of elderly households at the municipal level before 2008 to calculate the number of predicted recipients.

had changed due to the establishment of Sejong Special Self-Governing City and administrative area integrations.[14] Secondly, we have excluded the Jeju Special Self-Governing Province from our sample. Jeju is geographically isolated from the rest of Korea by the sea, and it also differs significantly in terms of local governance and immigration policy. Therefore, we believe that Jeju may possess potentially distinct characteristics as a local government unit. Lastly, we omitted regions with missing data from the local finance expenditure, including Sacheon City in Gyeongsangnam-do, Wanju County in Jeollabuk-do, and Gimhae City in Gyeongsangnam-do. Our sample ultimately includes 221 municipal units out of the 227 that existed in South Korea in 2013.

Table 2 displays the summary statistics of our sample. Panel A provides summary statistics related to suicide rates. The average suicide rate for those aged 65 and older stands at 69.92 per 100,000 — with male rates at 108.7 and female rates at 43.29. Notably, the suicide rate for the 80 and older is 100.3 per 100,000 (172.1 for males and 70.02 for females), highlighting a notably elevated suicide rate in this age group compared to the 65-79 bracket.

Panel B presents summary statistics for the control variables. These control variables were constructed using data predating the analysis period, specifically data before 2013, as they may be potentially influenced by changes in welfare expenditure in the region. However, due to variations in the available data years for constructing these control variables, the data were collected from 2008 to 2012. The average difference in per capita welfare expenditure for individuals aged 65 and over slightly exceeds 1.5 million KRW, while the difference in "predicted" welfare budget constructed as an IV averages around 1.2 million KRW.

The 2011 recipient rate for the Basic Livelihood Security Program targeting the elderly poor aged 65 and over, averages around 7%. Regarding the employment figures from 2008,

[14]The dropped regions include Cheongju City and Cheongwon County in Chungcheongbuk-do, Gongju City and Yeongi County in Chungcheongnam-do, and Sejong Special Self-Governing City.

the self-employed constitute 26.6% of the total employed population, those in manufacturing sectors account for 23.1%, and the employment-to-population ratio sits at 26.2%. This last metric indicates the number of employed people in a given area in relation to its residential population, not the employment rate of its residents. For example, in the satellite city of B, which is mainly composed of residents who work in area A, the employed population relative to the residential population may appear quite low. As of 2008, the average share of the population aged 65 and over is 15%, and the divorce rate per 1,000 people averages at 2.2 cases. The share of single-person households averages at 10.5%, and the voter turnout is 49.75%. As of 2011, there is an average of 1.698 medical facilities per 1,000 people, with only 0.001 being tertiary referral hospitals.[15][16] The number of nursing facilities per 1,000 elderly individuals averages at 0.161.

4 Empirical Strategy

To estimate the impact of welfare expenditure on suicide rates, we can consider the following fixed-effects model as an empirical analysis framework.

$$y_{i,t} = \alpha_0 + \alpha_i + \alpha_t + \beta expenditure_{i,t} + \gamma X_{i,t} + \epsilon_{i,t} \tag{1}$$

Here, variable $y_{i,t}$ represents elderly suicide rates in municipal i in year t, $expenditure_{i,t}$ represents elderly welfare expenditure in municipal i in year t. $X_{i,t}$ is a vector of control variables, while α_i and α_t and respectively denote municipal and year fixed effects.

As mentioned in the introduction, there might be endogeneity between the indepen-

[15] According to Article 3 of the Medical Service Act, medical facilities are places where healthcare professionals provide medical and obstetric services to the general public or specific groups. They are categorized into tertiary hospitals, hospitals, dental hospitals, traditional medicine hospitals, nursing homes, dental clinics, traditional medicine clinics, and maternity clinics.

[16] A tertiary referral hospital is a medical facility that offers tertiary care, a specialized level of healthcare accessed from experts in a large hospital following a referral from primary and secondary care providers.

dent variable, per capita elderly welfare expenditure, and the dependent variable. Economic shocks in a specific region can alter local fiscal conditions and influence fiscal policy priorities, thereby impacting the local government's welfare expenditure. Concurrently, these shocks could affect the error term in Eq. (1), influencing elderly suicide rates. Using the fixed effects model described earlier could lead to biased estimates since unobserved time-varying factors might influence both the welfare expenditure and suicide rates. For instance, a negative economic shock in a region could decrease residents' incomes, leading to increased welfare expenditure for supporting low-income individuals, such as food stamps or SNAP (Notowidigdo, 2020). Given that such economic shocks can also raise suicide rates (Ruhm, 2000), this scenario could underestimate the suicide reduction effect of welfare expenditure.

To mitigate concerns related to endogeneity, we developed an Instrumental Variable (IV) method, drawing inspiration from Currie and Gruber (1996). This IV simulates how municipal elderly welfare expenditure would have changed, assuming that recipient rates and the population remained fixed at predetermined levels.[17] For this IV, we employed demographic data from 2008 and Basic Pension recipient data from 2012 for each municipality. While earlier Basic Pension recipient data would have been ideal to capture more pension system changes, we made do with the earliest available data from 2012. Thus, our analysis predicted variations in a municipality's welfare expenditure due to changes in Basic Pension amounts implemented nationwide from 2013 to 2020, based on 2008 demographic data and 2012 Basic Pension recipient data.

Specifically, the predicted value of the 2014 municipal-level Basic Pension expenditure is

[17]We utilized data on elderly welfare expenditure rather than expenditure for the Basic Pension. This decision was made due to the unavailability of pension expenditure data for each municipality in the Local Finance 365 database.

calculated as follows:

$$\begin{aligned}\text{2014 Basic Pension expenditure} = &(1)\ \text{2014 Predicted Population of Elderly Individuals} \\ &\times (2)\ \text{2012 Basic Pension Recipient Rate} \\ &\times (3)\ \text{2014 Average Annual Pension Amount}\end{aligned}$$

The first term is the 'predicted' population aged 65 and over. We base our population prediction on the 2008 age-specific population distribution. For 2009, the population aged 65 and over is formulated by adding the 2008 population aged 64 and subtracting a portion of the 2008 population aged 65 due to mortality. This subtraction uses gender-specific mortality rates from 2008. Next, the recipient rate variable remains fixed at the 2012 municipal-level and gender-specific recipient rates throughout our analysis period. Lastly, we use the average annual pension amount based on a uniform application nationwide for each year.

Our simulated IV must meet both the relevance and exclusion conditions to be considered valid. For the relevance condition, it's imperative that Basic Pension expenditure constitutes a significant portion of municipal elderly welfare expenditure. Additionally, the predicted values for the elderly population (aged 65 and over) should consistently align with the actual elderly population at the municipal level during our analysis years. In Figure 4, we compare annual variations between the actual and predicted elderly welfare expenditures at the municipal level. Though there are discrepancies between these time series, the predicted values replicate the annual changes in elderly welfare expenditure closely. Moreover, the first-stage regression analysis, which we'll delve into in Section 5, yields an F-statistic of 29.07, far exceeding the minimum F-statistic threshold of 10 (Stock and Yogo, 2005).[18]

For the exclusion restriction, it is important to note that our predicted IV has two primary characteristics. Firstly, the changes in the Basic Pension amount are set by the central

[18]In addition, in Figure 5, we plot the 1st stage relationship between the two variables, confirming that a certain degree of linear relationship between the two variables is satisfied.

government and applied nationwide. Nevertheless, using the actual expenditure allocated for the Basic Pension as an instrument variable is infeasible because the real expenditure is influenced by various unobservable regional shocks that affect the regional economy, such as income fluctuations and population movements. Thus, to eliminate these endogenous components, we utilize changes in the Basic Pension amount. We *predict* the changes in the number of recipients for each municipalities based on the 2008 age distribution and 2012 recipient data, and constructed the predicted value of Basic Pension expenditure per capita.

Nonetheless, our predicted IV possesses two potential limitations. First, even when formulating predicted Basic Pension amounts from past data, the exclusion restriction condition may be violated. We use the 2012 Basic Pension recipient data to create predicted per capita Basic Pension expenditures. If suicide rate trends varied between regions with different Basic Pension recipient shares in 2012, our IV estimation might be biased. For the predicted IV to be valid, the Basic Pension recipient share used in its construction should be exogenous. Goldsmith-Pinkham et al. (2020), in their discussion on the validity of Bartik IV, argue that the industrial composition across regions in the base year should be exogenous. This same principle applies to our predicted IV. We will evaluate the exogeneity of Basic Pension recipient share using a placebo test in Section 5.2.

Second, predicting the annual elderly welfare expenditure is challenging since the Basic Pension amount remains relatively constant each year. Major variations took place around 2014 and 2018, aligning with significant BP system shifts. In other years, modifications mainly addressed inflation. This challenge arises from the fact that the actual elderly welfare expenditure is influenced by various factors, apart from slight adjustments in the Basic Pension standard amount.

Given these two issues, we employ a long-difference model as shown below instead of a

fixed-effects model.

$$\Delta y_{i,t} = \alpha_0 + \beta \Delta expenditure_{i,t} + \gamma X_{i,t} + \eta_{i,t} \tag{2}$$

The long-difference model expressed in Eq. (2) estimates the impact of changes in elderly welfare expenditure across local governments from 2013 to 2019 on corresponding changes in elderly suicide rates. It iss vital to recognize that nationwide cohort changes or macroeconomic changes impacting suicide rates are absorbed by the constant term in this difference model. The coefficient of interest in the long-difference model can be interpreted as the change in the number of suicides per 100,000 individuals when elderly welfare expenditure (per capita) increases by 1 million won.

In our model, the exclusion restriction holds when the 2012 Basic Pension recipient rate is orthogonal to unobservable shocks potentially affecting changes in the suicide rate. If there are substantial variations in the Basic Pension recipient rate among different regions, then economic, demographic, and amenity factors may also show substantial differences. If the trend in the suicide rate is also distinctly associated with these variables, the exclusion restriction may not be valid. To address this, we control for the pre-period regional differences in economic, demographic, and amenity variables as outlined in Table 2.

The controlled variables encompassed within our regression model feature economic and social capital-related elements (e.g., the ratio of basic livelihood recipients to the population aged 65 and over in 2011, employment as a percentage of the resident population in 2008, the percentage of self-employed individuals among employed residents, the percentage of manufacturing sector employees among the employed population, voter turnout in 2008), healthcare accessibility measures such as the number of care facilities per thousand people, the number of tertiary hospitals per thousand people, and the number of care hospitals per thousand elderly people, as well as population-related variables (e.g., the log population size and percentage of the population aged 65 and over based on the 2008 data, divorce rate, and

the percentage of single-person households). Including these variables as control variables in the long-difference model has the same effect as controlling for linear trends associated with these variables in a fixed-effects model.

Next, to mitigate the influence of provincial economic shocks during our analytical period, we include province fixed effects. Finally, to account for any pre-existing trends that could vary by regions, we control pre-trends in the elderly suicide rate from 2008 to 2011. The reason for including a pre-trend variable is that our model essentially estimates the effect of welfare expenditure by comparing regions with a high and low number of Basic Pension recipients based on the 2012 data. It is conceivable that elderly suicide rate trends between these regions may have been different.

5 Results

5.1 Main Findings

Before analyzing the impact of an increase in elderly welfare expenditure on the reduction of municipal-level elderly suicide rates, Table 3 presents the 1st stage results of the IV. The estimated coefficient for the elderly welfare expenditure (per capita) is 1.270, and is significantly different from zero. Specifically, during the analysis period, a predicted rise of 1 million won in elderly welfare expenditure corresponds to an actual increase of 1.27 million won. Other variables of statistical significance are the number of Nursing Homes (per 1,000 elderly) and a city dummy variable, with coefficients of -0.254 and -0.118, respectively. The coefficient for Nursing Homes suggests that regions with a pre-established infrastructure of nursing homes experienced a decrease in elderly welfare expenditur. This may suggest that areas with ample nursing homes previously required lesser incremental welfare spendings for elderly infrastructure, leading to the negative coefficient.

Table 4 presents the estimated effects of increased elderly welfare expenditure from 2013

to 2019 on suicide rates. Columns (1)-(3) provide OLS estimation outcomes without using an IV, whereas columns (4)-(6) present the results using our IV. Both Model (1) and (4) include control variables constructed based on the pre-analysis period. Model (2) and (5) additionally control for provincial fixed effects, considering the potential variability in suicide rate across broader regions. Finally, Model (3) and (6) account for the pre-existing suicide rate trends from 2008 to 2011, aiming to address the potential for distinct trends in suicide rates during our analysis period.

Our findings indicate that the increase in elderly welfare expenditure at the local government level is estimated to reduce the suicide rate. When compared to the OLS results in columns (1)-(3), the IV' results differ significantly in both the magnitude of the estimates and their statistical significance. This suggests that the presence of endogeneity between unobservable economic shocks and per capita welfare expenditure can substantially influence the actual estimates. As mentioned earlier, negative economic shocks at the regional level are closely linked to the increase in per capita welfare expenditure, especially with the rise in the low-income population. This association might also be related to an increase in the suicide rate, potentially leading to an underestimation of the suicide reduction effect.

Comparing the estimation results between the models, with a focus on the IV results, there is a noticeable difference between Models (4) and (5). This indicates that controlling for provincial fixed effects can have a substantial impact on the estimates. Controlling provincial fixed effects means partially controlling for shocks that are unobservable at the provincial level, rectifying the endogeneity concern with the IV. In our analysis, our preferred model is Model (6), which incorporates controls for pre-existing trends in suicide rates at the municipal level. The estimation results remain largely consistent with those in column (5). According to the estimation, in column (6), a 1 million won increase in elderly welfare expenditure (per capita) over the analysis periods corresponds to a reduction of 38.37 suicides per 100,000

elderly individuals. Drawing a comparison between the welfare expenditure growth rates in the bottom 25% and the top 75% regions, the latter witnessed an additional reduction of approximately 23.98 suicides per 100,000 elderly inhabitants.

Table 5 presents the heterogeneity analysis results regarding whether the reduction effect of increased elderly welfare expenditure on the suicide rate varies by gender, age, educational attainment (middle school graduate or less), and household composition (living alone). To conduct the analysis, we disaggregate the municipal-level suicide rates for individuals aged 65 and older by gender, age, educational attainment, and household composition, and use them as dependent variables.[19]

Initially, Panel A examines the heterogeneity by gender. Our preferred model [columns (3) and (6)] suggests that a 1 million won increase in elderly welfare expenditure (per capita) over the analysis period led to a decrease in the suicide rate of approximately 73.55 per 100,000 elderly men –a statistically significant. In contrast, for women, the estimated effect was -16.47, which was relatively small in magnitude and not statistically different from zero. The difference in the estimated effects may initially stem from the fact that the suicide rate for elderly men was higher than that of elderly women. However, even after accounting for the difference in suicide rates between men and women, the suicide reduction effect was relatively more pronounced in men.[20] Our findings echo previous studies that highlight the

[19]The CDS includes information about gender, age, and educational levels. However, population information broken down by municipal and educational level cannot be obtained from MOIS's resident registration population statistics. Therefore, in this study, we calculated population estimates for municipal and education levels using the 2005, 2010, 2015, 2020 population census sample data from the Korea National Statistical Office. We then combined these estimates to calculate the elderly suicide rates by municipal and educational level. While the CDS does not provide exact information about one-person households, marital status information for those aged 65 and above was used to classify widowed individuals as one-person households. Population data for municipal and one-person households were calculated using the same methodology as for municipal and educational levels, utilizing the weights from the population census from the Korea National Statistical Office.

[20]As of 2013, the suicide rate per 100,000 elderly men and women was 103.72 and 36.11, respectively. When we divide the estimated effects in Table 5 by these numbers, a 100 million won increase in welfare expenditure (per capita) reduces the suicide rate by 74.24% for men and 49.85% for women.

significant impact of expansionary fiscal policies on suicide rates in elderly men, but not in women (Antonakakis and Collins, 2015; Balan-Cohen, 2008; Minoiu and Andres, 2008).

One hypothesis for the differing suicide reduction effects between genders is that elderly men in South Korea are more vulnerable to economic hardships, making welfare policies more impactful on them. For instance, liquidity constraints for elderly men may impede consumption smoothing, particularly when compared to their female counterparts. This is because elderly men may have less intimate relationships with their offspring compared to elderly women, and in such cases, it can be more difficult for them to expect private income transfers from their children. Pak and Choung (2020) has demonstrated that, for South Korean elderly males not for elderly female, a pronounced correlation exists between suicide attempts and relative income inequality. Investigating whether the extent to which elderly individuals can smooth consumption when the liquidity-constraint is binding varies by gender, and exploring whether this phenomenon is related to the heterogeneity in suicide reduction effects is an interesting research topic. However, due to the lack of available data for individual-level analysis, we intend to leave this for future research.

In Panel B, we investigate whether the suicide reduction effect of welfare expenditure varies by age group. We disaggregate the elderly suicide rates into 65-79 years old and 80 years and older. The estimated results confirm that the observed suicide reduction effects in Table 4 are primarily attributed to the suicide reduction effects observed in individuals aged 80 years and older. Similar to the results based on gender, some of the differences in the estimates can be attributed to the higher suicide rates in the 80 and older age group relative to the under-80 age group. However, even accounting for the age-related differences in suicide rates, the suicide reduction effects are notably more significant in the 80 years and older age group. Furthermore, in Appendix Table A1, we provide the estimated results by gender for the 80 years and older segment. It is evident that the significant decline in suicide

rates within the 80 years and older cohort is predominantly observed among males.[21]

One plausible explanation for the more pronounced treatment effect in those aged 80 and older relates to their higher likelihood of receiving the Basic Pension compared to other age groups. In Appendix Table A2, we present the probability of a household receiving Basic Pension based on the educational attainment, age of the household head, and the number of household members. To calculate the probability of receiving benefits, we first compute the household income utilized in the eligibility assessment for Basic Pension, drawing from SHFLC for 2012 and 2013.[22] Appendix Table A2 shows that 85.34% of household heads aged 80 and older have a probability of obtaining Basic Pensions which is higher compared to household heads aged 65-80. In other words, household heads aged 80 and older were more likely to be constrained by liquidity constraints compared to younger age groups, making it more likely that they receive public transfer support. Consequently, this cohort may have seen a more significant decrease in suicides during our study period, a change chiefly driven by the bolstered Basic Pension system, compared to younger age groups.

Finally, Panels C and D examine the heterogeneous effects of welfare expenditure based on educational level and household composition. While the impact of welfare spending did not exhibit heterogeneity when segmented by educational level, we observed a varied effect on suicide rates based on household size, particularly in single-person households. Based on the most preferred models, it is found that an increase of 1 million won per capita in the elderly

[21]In the group of elderly individuals aged 80 and older, we did not separately examine the heterogeneous treatment effects based on factors such as education level and living alone status. This decision was made because when restricting the sample to those aged 80 and older, there were limited observations available for variables related to education level and living alone, which could introduce measurement errors when constructing the dependent variable.

[22]To calculate the Recognized Income for the bottom 70% threshold, a requirement for Basic Pension eligibility, the Recognized Income amount is computed by combining household income with the assessed income value of property. We applied the Recognized Income calculation method provided by Bokjiro, a government website, to the income and property information from the SHFLC to determine the Recognized Income amount. For more detailed information about the calculation formula, refer to the following website (https://www.bokjiro.go.kr/ssis-tbu/twatbz/mkclAsis/mkclInsertBspnPage.do).

welfare expenditure leads to a decrease of approximately 125.666 in the suicide rate per 100,000 single-person households, which is statistically significant. In contrast, the estimate for households with more than or equal to two people is –8.971, indicating a relatively smaller magnitude of the estimate, and it also failed to reject the null hypothesis of no difference from zero statistically. However, we should note that the characteristic of being a single-person household is highly correlated with age, making it difficult to distinguish whether the observed heterogeneity is due to the status of being a single-person household or due to age. In Appendix Table A1, Panel B, to partially control for the heterogeneous effects by age, we present the estimated results of the suicide rate among the elderly aged 80 and over, disaggregated by household size. The findings continue to show that the effect of reduced suicide rates is significantly pronounced in single-person households. Economic support for the elderly is generally thought to lead to a reduction in suicide rates through increased economic stability, reduced social isolation, and improved access to health care. These pathways may operate more effectively in single-person households than in bigger households.

5.2 Internal Validity Check

The variations in the IV used in our study are primarily stem from the 2012 regional Basic Pension recipient rate. Thus, understanding the disparities between municipalities with high and low recipient rates during that period is pivotal. The recipient rate reflects myriad factors, encompassing economic conditions and population structure within a municipality. As such, recipient rate differences can lead to varied levels and changes of elderly suicide rates across municipalities. Ultimately, the suicide rate reduction effect of welfare expenditure in our study can be derived through a comparison of the changes in suicide rate between regions with high and low Basic Pension recipient rates using a difference-in-differences approach.

Therefore, it is essential that there is no statistical relationship between the 2012 Basic Pension recipient rate and the pre-trends in suicide rates, meaning that the parallel trends assumption must hold.

In Figure 6, we presents the trends in elderly suicide rates for regions with the top 25% and bottom 25% Basic Pension recipient rates in 2012. While the top 25% regions exhibited higher levels of elderly suicide rates compared to the bottom 25% regions, the trends in suicide rates between the two regions appeared to be similar from 2012 to 2013. However, after the 2014 Basic Pension reform, when elderly welfare expenditure increased, the suicide rate in the top 25% regions showed a faster decline compared to the bottom 25% regions.

To rigorously investigate the statistical relationship between the pre-trends in elderly suicide rates and the IV, Columns (1) and (2) of Table 6 present the estimated results using the difference in elderly suicide rates (per 100,000 elderly individuals) from 2008 and 2011 as the dependent variable. The estimated results using an IV are presented in column (2), with an estimate of 5.861. This estimate, when compared to the estimate in Table 4, which is –38.371, is small in absolute magnitude and statistically not significant. This suggests that the suicide reduction effect estimated in our main analysis is unlikely attributable to the difference in pre-trends in suicide rates preceding our study window.

Columns (3) and (4) of Table 6 provide placebo test outcomes for the 55-64 age bracket, ineligible for Basic Pension but shows parallel suicide rate trends to the target elderly population before 2013. If the trend in suicide rates between regions with low and high Basic Pension recipient rates is different, and if these differences significantly affect the estimated results, then we would anticipate significant results in the placebo analysis. The estimate in column (4) is 1.640, indicating a very small effect size, and it is not statistically significant.

5.3 Mechanism Analysis

In the mechanism analysis, we specifically examine how increased welfare spending targeting the elderly affects the income and consumption of elderly households. As highlighted previously, the predominant factor behind the surge in per capita welfare expenditure for the elderly during our study period was the 2014 Basic Pension reform. Consequently, our mechanism analysis focuses on assessing the ramifications of this reform on elderly household income and consumption.

Our analysis utilizes data from the Survey of Household Finances and Living Conditions spanning 2012 to 2016, and we confine our sample to households heads aged 55 and above. Within this sample, we designated households with heads aged 55-64 as the control group and those with heads aged 65 and older as the treatment group.[23] The dataset for our analysis encompasses 40,441 observations, with the detailed summary statistics displayed in Appendix Table A3.

The beneficiaries of the basic pension are defined based on age, specifically those aged 65 and above, and given that the benefit amount increased due to the 2014 reform, we use the following difference-in-differences model.

$$y_{i,a,t} = \alpha + \alpha_t + \beta I(age_a \geqslant 65) + \beta_{DID} I(age_a \geqslant 65) \times Post_t + \gamma X_{i,a,t} + \eta_{i,a,t} \qquad (3)$$

This model is similar to the one used by Koh and Yang (2021), which examined the impact of the 2008 reform on private income transfers from children. In this model, $y_{i,a,t}$ represents the income or expenditure at the household i, where the household head age a at the time t. The variable $I(age_a \geqslant 65)$ refers to beneficiary households, with a value of 1 when

[23] Since the Basic Pension targets solely households headed by individuals aged 65 and over, whose incomes fall beneath the 70th percentile of the elderly income distribution, it's feasible to differentiate households within this age range into treatment and control groups. However, since income is influenced by household choices, determining treatment based on income could potentially embed endogeneity in our treatment variable.

the household head is aged 65 or older. The parameter of interest in the analysis is denoted as β_{DID}, reflecting the impact of the 2014 reform on the income and consumption of beneficiary households. Differences in income and consumption resulting from public transfers received by households with household heads aged 55-64 and those aged 65 and above before 2014 are estimated using data from years preceding 2014. Finally, we include age, educational attainment, and household size as explanatory variables to control for their effects on income and consumption.

Table 7 presents the estimated results. Panel A offers results using income-related variables as dependent variables.[24] The 2014 reform is associated with an increase in public transfers by 127.766 million KRW annually. However, private income transfers from adult children decreased by approximately 18.019 million KRW, resulting in a net increase in total income transfers of 109.747 million KRW. On the other hand, beneficiary households appeared to respond to the increase in public transfers by reducing labor income, estimated to decrease by 190.856 million KRW. While these households had previously relied on labor for income due to insufficient retirement assets, the introduction of stable income caused a decline in labor supply, with beneficiaries opting for more leisure time. Finally, in column (5), as beneficiary households responded to the increase in public transfers by reducing their labor supply, there was no significant change in total income.

In Panel B, we provide the estimated results using consumption-related variables as dependent variables. Remarkably, despite no increase in total income, the consumption of elderly households increased following the 2014 reform.[25] This is evident in column (10),

[24]To construct a treatment group more similar to the control group, Appendix Table A4 defines the treatment group as ages 65-74 and presents the estimated results. The findings are quantitatively and qualitatively very similar to those in Table 7.

[25]Such findings are in line with the results of Ahn et al. (2021), which suggest that the elderly population in Korea has experienced an increase in consumption insurance against transitory and permanent income shocks during 1998-2018.

which highlights a consumption surge of 57.258 million KRW. The increase in expenditure among beneficiary households, despite reduced labor supply and no corresponding annual income increase is an interesting finding. A plausible interpretation is that the legally mandated Basic Pension reform may have reduced income volatility, enhancing the permanent income of beneficiary households. This, in turn, could explain the escalated consumption levels without a parallel rise in annual income.

Next, in columns (6) to (9) of Table 7, we present the effects of the Basic Pension reform for each consumption categories. The estimated results indicate that the Basic Pension reform led to an increase in food, medical-related, and transportation-related expenses among beneficiary households. Specifically, the increase in public transfer income due to the expansion of the Basic Pension led to an annual increase of 16.348 million KRW in food spending and a 12.120 million KRW increase in medical-related expenses among beneficiary households. An intriguing observation is the rise in medical-related expenses for the beneficiary households aligning with the increased public transfer income. It is conceivable that elderly households, lacking substantial asset for consumption smoothing, might have previously limited their medical expenses as a form of precautionary savings, even when facing adverse health conditions.

Lastly, as illustrated in column (9), the impact of the Basic Pension reform is estimated to boost the transportation-related expenditure of beneficiary households by 10.796 million KRW. The increased leisure time, a consequence of reduced labor participation, may have promoted greater transportation usage for pursuits like social participation, travel, and other recreational activities, thereby increasing transportation costs.

In conclusion, while the 2014 Basic Pension reform did not increase annual income of elderly households, it did raise permanent income. This led elderly households to increase their consumption and leisure activities. The subsequent increase in utility, as observed in our

mechanism analysis, is believed to be associated with the noted decrease in elderly suicide rates during our study period.

6 Conclusion

In this paper, we sought to discern the causal relationship between elderly welfare expenditure and suicide rates, contextualizing within South Korea's unique socio-economic landscape where the social safety net remains underdeveloped and elderly poverty is pervasive. To estimate the causal impact of increasing elderly welfare expenditure, we leverage spatial variations in welfare expenditure at the municipality level and constructing a simulated IV based on the Basic Pension system reforms. We provide evidence that rise in elderly welfare expenditure was consequential in reducing elderly suicide rates. Specifically, regions experiencing a 1 million KRW increment in elderly welfare expenditure observed a decline of 38.37 suicides per 100,000 elders, a profound contrast to regions without such expenditure increments.

Furthermore, our heterogeneity analysis illuminated gender and age disparities in treatment effects. Most notably, the suicide rate reduction was predominantly observed in the elderly male population, with the effect being particularly salient among those aged 80 and above. This suggests that increased welfare expenditure is especially beneficial for elderly individuals facing more severe liquidity constraints.

In terms of the underlying mechanism, our difference-in-differences analysis of the 2014 Basic Pension reform shows that while treated households experienced increased public transfer income, they concurrently reduced their labor income, leaving their total income largely unchanged. Nonetheless, these households exhibited elevated consumption, likely due to the reinforced legally mandated Basic Pension system bolstering their permanent income.

In sum, our investigation elucidates the pivotal role of elderly welfare expenditure in ame-

liorating suicide rates among the elderly in South Korea. The rise in consumption and leisure activities, despite stagnant annual income, hints at a critical pathway through which welfare expenditure uplifts the well-being of the elderly, thereby reducing suicide rates. This insight not only broadens the understanding of welfare's impact on health but also underscores the necessity of tailored welfare strategies in diverse socio-economic environments.

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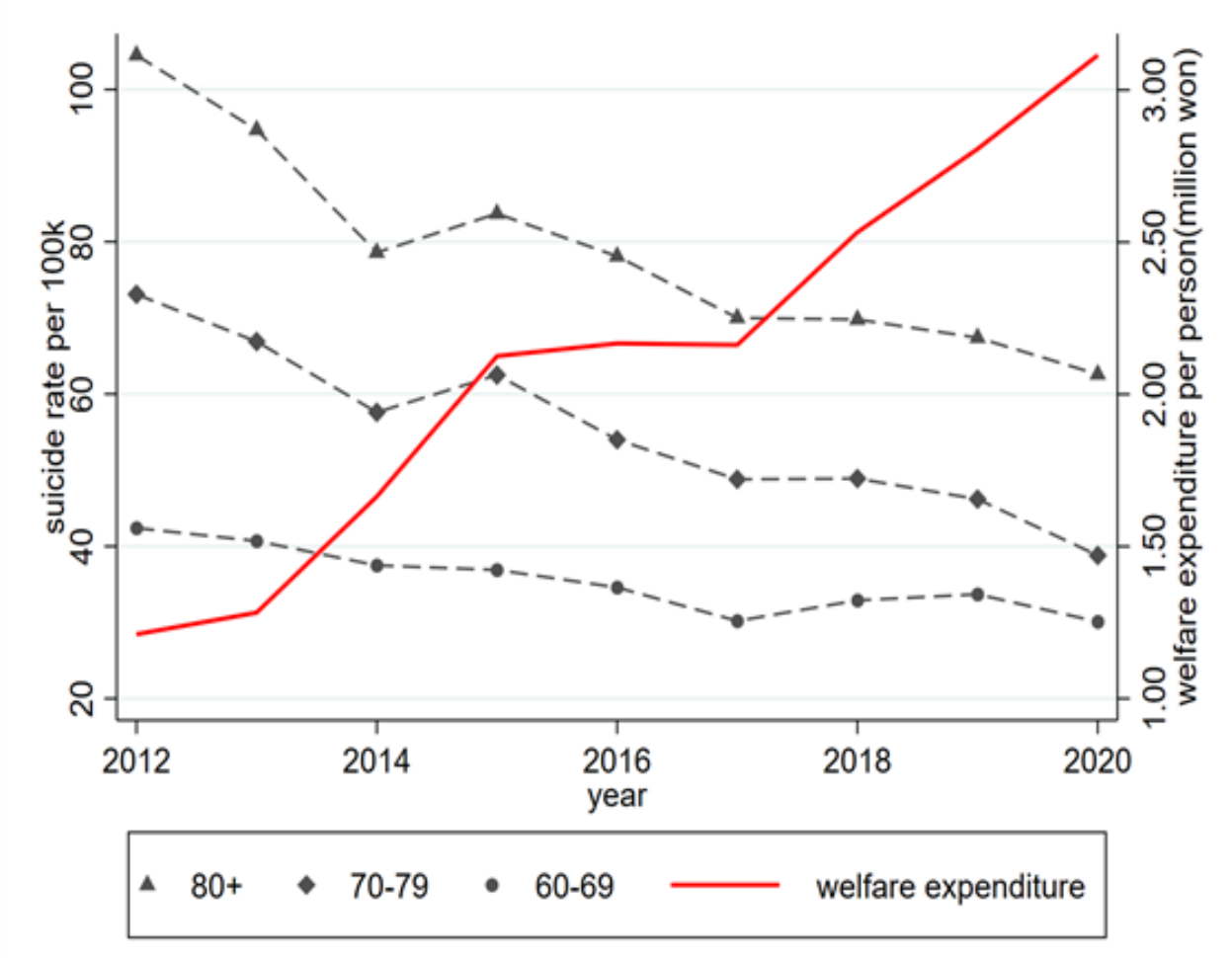
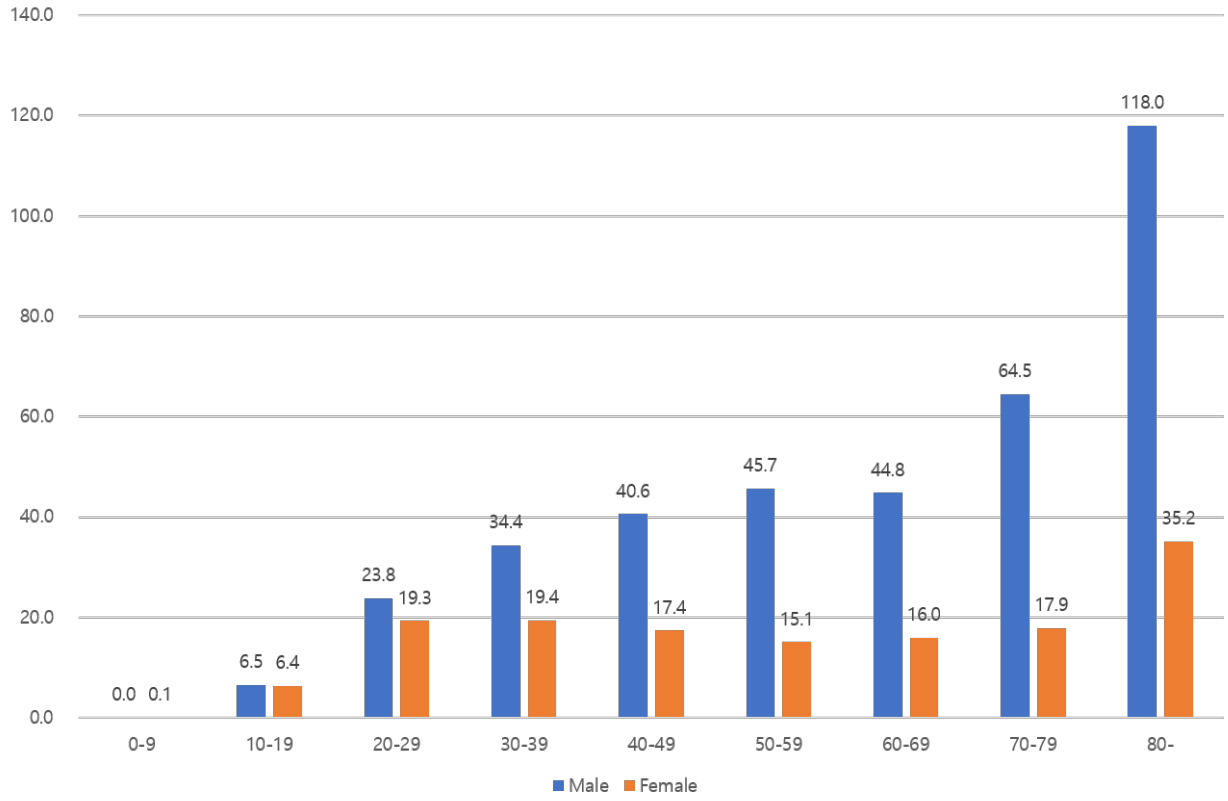
Figure 1: Elderly Suicide Rate and Welfare Expenditure over Time



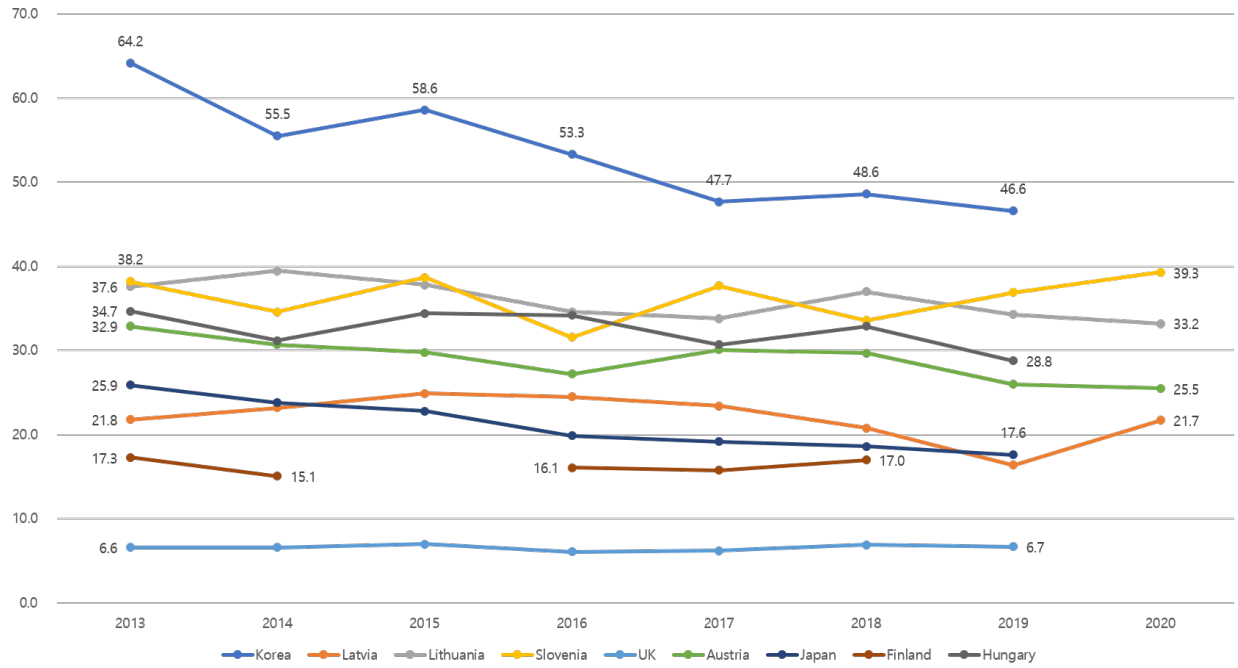
This figure plots the suicide rates per 100,000 people by three age groups (dashed line), and the per capita welfare expenditure for the elderly(solid line) annually from 2012 to 2020.

Figure 2: Suicide Rate by Gender & Age Groups in South Korea



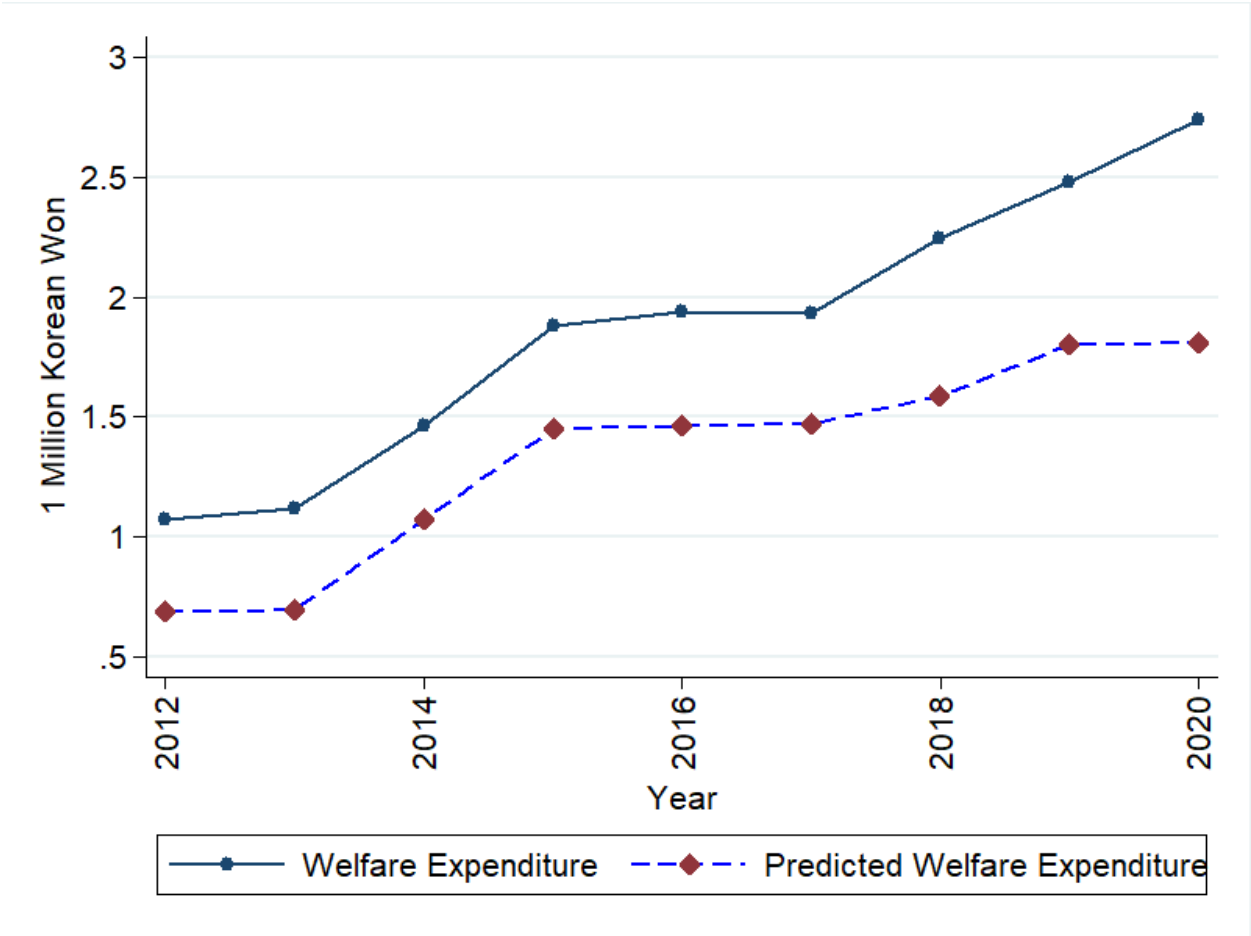
This figure presents the age-specific suicide rates in South Korea for the year 2020. The suicide rate for men is presented with blue bars, while the suicide rate for women is shown with red bars.

Figure 3: Elderly Suicide Rate(Age⩾ 65) Trends among OECD Countries



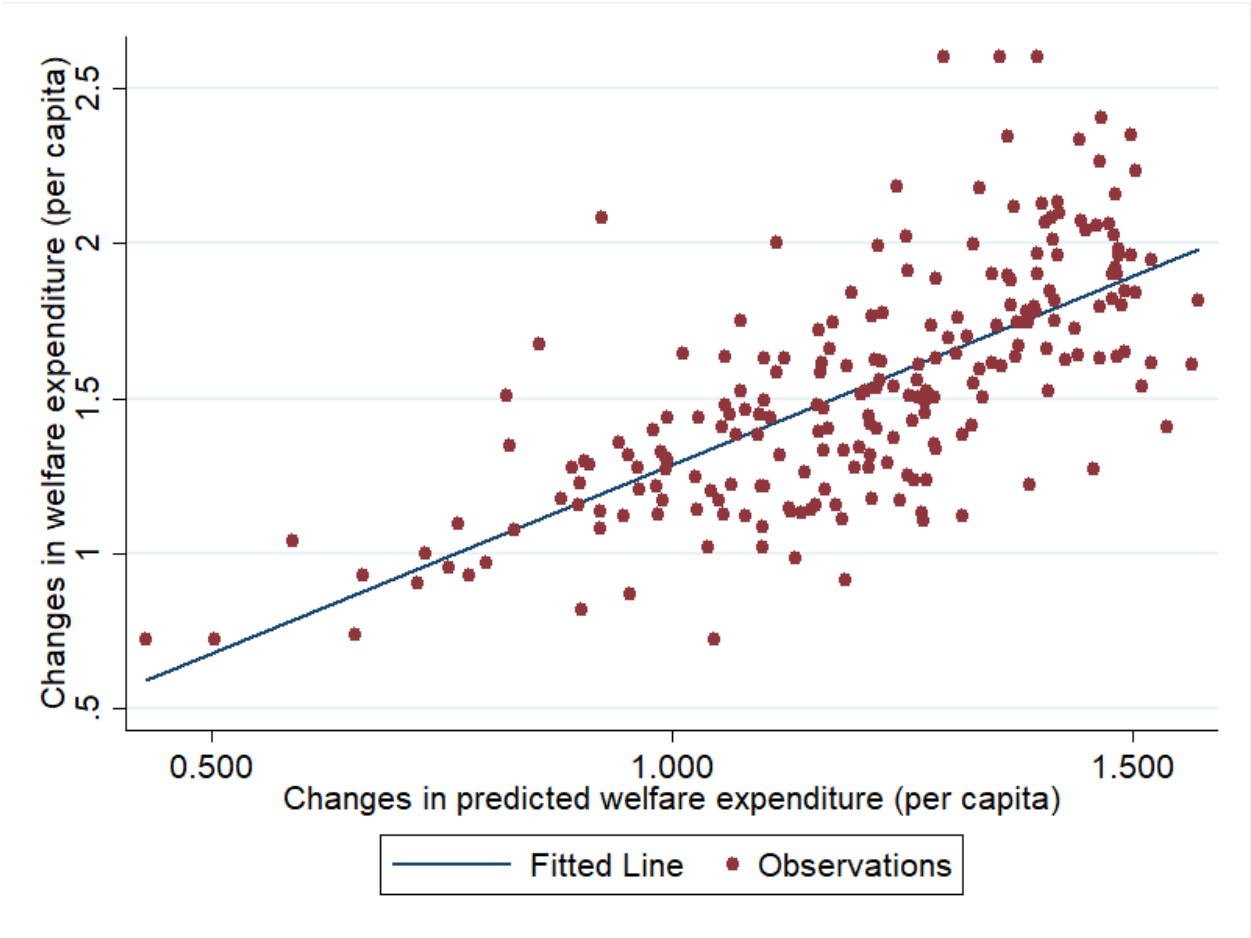
This figure compares changes in suicide rates among individuals aged 65 and above in South Korea versus selected OECD member countries (Latvia, Lithuania, Slovenia, United Kingdom, Austria, Japan, Finland, Hungary) from 2013 to 2020.

Figure 4: Welfare Expenditure for the Elder per Capita (Actual vs Predicted)



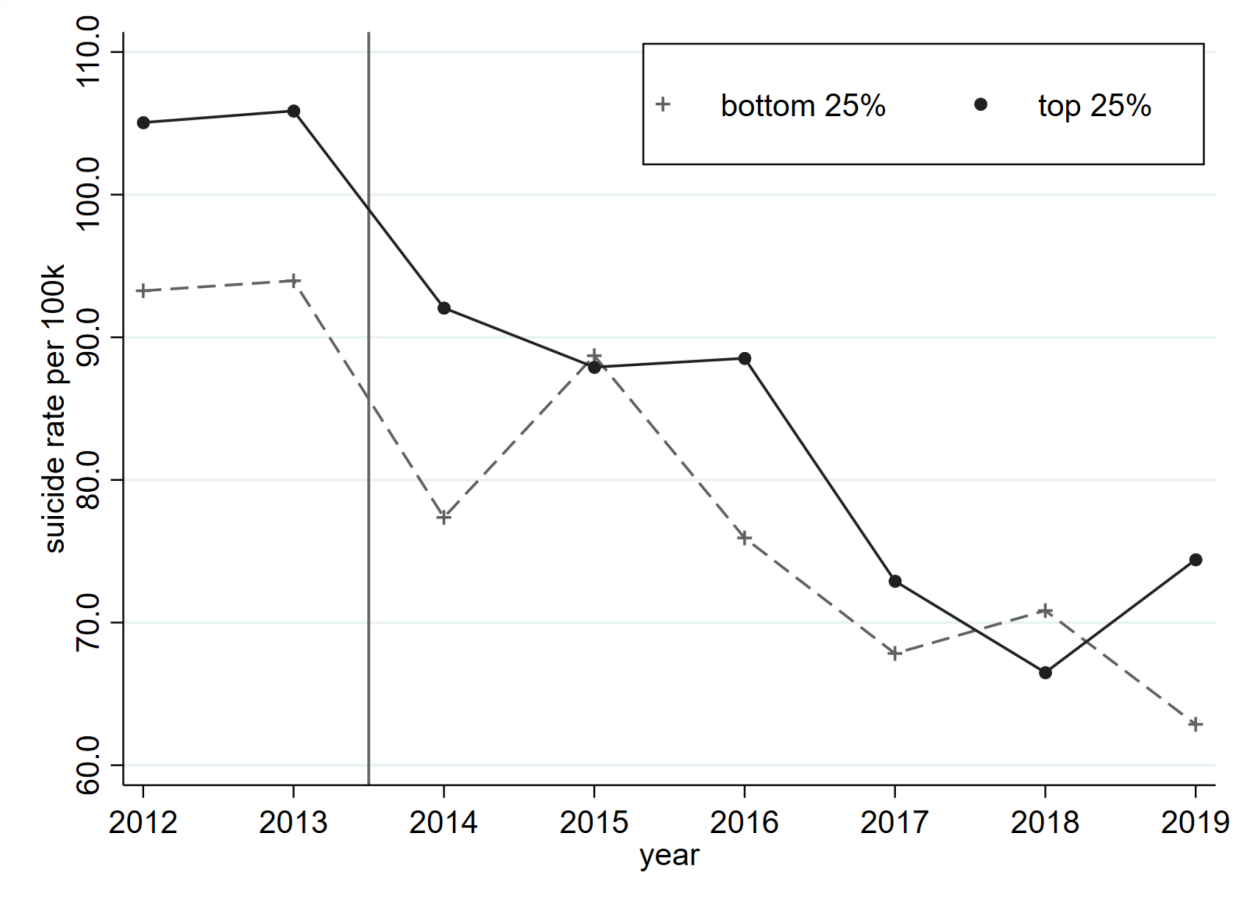
This figure compare annual variations between the actual(dashed line) and predicted(solid line) elderly welfare expenditures at the municipal level from 2012 to 2019. The predicted value of the 2014 municipal-level Basic Pension expenditure is calculated as follows: (1) 2014 Predicted Population of Elderly Individuals (aged 65 and over) × (2) 2012 Municipal-level Basic Pension Recipient Rate × (3) 2014 Average Annual Pension Amount.

Figure 5: First Stage Results



This figure plot the 1st stage relationship between the changes in predicted welfare expenditure (X-axis) and the changes in actual welfare expenditure (Y-axis) at the municipal level. The linear relationship between the two variables is indicated by a dotted line.

Figure 6: Suicide Rate in the Top and Bottom 25% of Basic Pension recipient Areas



This figure plots the trends in elderly suicide rates(per 100k) for regions with the top 25% and bottom 25% Basic Pension recipient rates in 2012 from 2012 and 2019. While the top 25% regions exhibited higher levels of elderly suicide rates compared to the bottom 25% regions, the trends in suicide rates between the two regions appeared to be similar from 2012 to 2013.

Table 1: Changes in Basic Pension Standard Amount

Scheme	Period	Standard Payment in KRW
Basic Old-Age Pension	Jan, 2008 ∼ Mar. 2009	84,000
	Apr, 2009 ∼ Mar. 2010	88,000
	Apr, 2010 ∼ Mar. 2011	90,000
	Apr, 2011 ∼ Mar. 2012	91,200
	Apr, 2012 ∼ Mar. 2013	94,600
	Apr, 2013 ∼ Mar. 2014	96,800
	Apr, 2014 ∼ Jun. 2014	99,100
Basic Pension	Jul, 2014 ∼ Mar. 2015	200,000
	Apr, 2015 ∼ Mar. 2016	202,600
	Apr, 2016 ∼ Mar. 2017	204,010
	Apr, 2017 ∼ Mar. 2018	206,050
	Apr, 2018 ∼ Aug. 2018	209,960
	Sep, 2018 ∼ Mar. 2019	250,000
	Apr, 2019 ∼ Dec. 2019	253,750 (For Income 20% $\downarrow, 300,000$)
	Jan, 2020 ∼ Dec. 2020	254,760 (For Income 40% $\downarrow, 300,000$)
	Jan, 2021 ∼ Dec. 2021	300,000

This table presents changes in the Basic Pension's monthly average payment amount for single-person households from 2008 to 2021.

Table 2: Summary Statistics

Variables			Mean	SD	Min	Max
Dependent Variables						
Levels of Suicide Rates in 2012 (cases per 100,000 people)	Age 65 and over	Overall	69.92	28.63	0	156.6
		Male	108.7	51.96	0	293.1
		Female	43.29	24.27	0	144.2
	Age 80 and over	Overall	100.3	63.65	0	362.9
		Male	172.1	147.2	0	914.6
		Female	70.02	60.16	0	296.5
Difference in Suicide Rates (2013 2019)	Age 65 and over	Overall	-18.35	24.29	-138.3	50.77
		Male	-28.67	46.27	-238.4	80.73
		Female	-12.67	24.36	-88.73	71.93
	Age 80 and over	Overall	-25.44	66.66	-221.9	165.2
		Male	-30.53	157.7	-505.7	612.0
		Female	-26.74	64.34	-237.9	134.5
Explanatory Variables						
Welfare Expenditure (per capita of age$\geqslant$ 65, \$1 Million Won, 2012)			1.219	0.347	0.472	2.126
Predicited Welfare Expenditure by IV (per capita of age$\geqslant$ 65, \$1 Million Won, 2012)			0.733	0.130	0.261	0.949
Difference in (per capita) Welfare Expenditure (per capita of age$\geqslant$ 65, \$1 Million Won, 2013$\sim$2019)			1.536	0.394	0.233	3.021
Difference in (per capita) predicted Welfare Expenditure (per capita of age$\geqslant$ 65, \$1 Million Won, 2013$\sim$2019)			1.206	0.217	0.429	1.570
Share of Basic Living Security(BLS) Recipients (age$\geqslant$ 65, 2011)			0.0699	0.0201	0.0203	0.135
Share of Self-Employed Workers (2008)			0.266	0.0832	0.0646	0.486
Share of Manufacture Workers (2008)			0.231	0.173	0.0226	0.753
Share of Employment to Population (2008)			0.262	0.213	0.0928	2.424
Log Population of Age 65 and Over (2008)			21885.5	14418.9	1768	81692
Share of Age 65 and Over (2008)			0.150	0.0734	0.0475	0.306
Divorce Rate (2008)			2.199	0.426	1.200	3.700
Share of Single Household (Age$\geqslant$ 65, 2008)			10.46	7.022	2.300	28
Voting Rate (2008)			49.75	7.198	37.80	72
# of Medical Facilities (per 1,000, 2011)			1.698	0.617	0.834	6.540
# of Tertiary General Hospital (per 1,000, 2011)			0.000809	0.00310	0	0.0261
# of Nursing Homes (per 1,000 of age$\geqslant$ 65, 2011)			0.161	0.132	0	0.752

This table displays the summary statistics of our sample. Panel A provides summary statistics related to suicide rates and Panel B presents summary statistics for the control variables. These control variables were constructed using data predating the analysis period, specifically data before 2013, as they may be potentially influenced by changes in welfare expenditure in the region. In the parentheses following the name of the control variable, we indicate the year used for constructing that variable.

Table 3: The First Stage Result: IV Regression

Explanatory Variables	Results
Predicted Welfare Expenditure (per capita)	1.270***
	(0.235)
Share of Basic Living Security(BLS) Recipients (Age$\geqslant$ 65)	-0.523
	(1.274)
Share of Self-Employed Workers	-0.561
	(0.520)
Share of Manufacture Workers	-0.171
	(0.192)
Share of Employment to Population	0.113
	(0.117)
Log of Elderly Population (Age$\geqslant$ 65)	-0.052
	(0.032)
Elderly Share (Age$\geqslant$ 65)	-0.718
	(1.784)
Voting Rate	-0.001
	(0.005)
Divorce Rate	0.061
	(0.057)
Share of Single Household	0.018
	(0.019)
# of Medical Facilities (per 1,000 people)	0.001
	(0.040)
# of Tertiary General Hospital (per 1,000 people)	3.068
	(4.301)
# of Nursing Homes (per 1,000 elderly)	-0.254*
	(0.135)
# of Nursing Homes (per 1,000 elderly)	-0.118*
	(0.064)
Observations	221
F	29.07
p	0.00

This table reports the 1st stage results estimating Eq. (2) to investigate the relavence between the changes in predicted welfare expenditure and the changes in actual welfare expenditure at the municipal level. Heteroskedasticity-robust standard errors are shown in parentheses. Significant at the 10 percent level, ** Significant at the 5 percent level, and *** Significant at the 1 percent level.

Table 4: The Effects of Welfare Expenditure on Elderly Suicide Rate

	(1)	(2)	(3)	(4)	(5)	(6)
		OLS			IV	
Δ in Welfare Expenditure (per capita)	-8.978 (6.488)	-7.327 (6.794)	-5.997 (6.515)	-14.554 (19.248)	-38.206** (19.370)	-38.371** (19.283)
Observations	221	221	221	221	221	221
Controls	✓	✓	✓	✓	✓	✓
Province FE		✓	✓		✓	✓
Pre-trend			✓			✓

This table presents the estimated effects of increased elderly welfare expenditure from 2013 to 2019 on suicide rates. Columns (1)-(3) provide OLS estimation outcomes without using an IV, whereas columns (4)-(6) present the results using our IV. Model (1) and (4) include control variables constructed based on the pre-analysis period. Model (2) and (5) additionally control for provincial fixed effects, considering the potential variability in suicide rate across broader regions. Model (3) and (6) account for the pre-existing suicide rate trends from 2008 to 2011, aiming to address the potential for distinct trends in suicide rates during our analysis period. Heteroskedasticity-robust standard errors are shown in parentheses. Significant at the 10 percent level, ** Significant at the 5 percent level, and *** Significant at the 1 percent level.

Table 5: Heterogeneous Effects

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Gender		Male			Female	
Δ in Welfare Expenditure	-44.937	-78.047**	-73.553**	-0.603	-17.694	-16.473
(per capita)	(37.309)	(37.684)	(35.879)	(21.935)	(19.003)	(19.515)
Panel B. Age		Age: 65 $\sim$ 79			Age: 80 and over	
Δ in Welfare Expenditure	-7.717	-18.536	-18.483	-57.626	-132.328***	-131.785***
(per capita)	(21.692)	(22.109)	(22.300)	(53.709)	(50.937)	(49.999)
Panel C. Education		$<$ Middle School			$\geqslant$ Middle School	
Δ in Welfare Expenditure	23.125	-41.947*	-41.898*	-53.574	-58.635*	-57.378*
(per capita)	(28.741)	(25.049)	(24.407)	(36.012)	(33.898)	(33.549)
Panel D. Household Composition		Living Alone			Having other members	
Δ in Welfare Expenditure	-37.644	-126.978*	-125.666*	10.689	-8.917	-8.971
(per capita)	(65.802)	(71.410)	(67.873)	(22.231)	(16.763)	(16.923)
Observations	221	221	221	221	221	221
Controls	✓	✓	✓	✓	✓	✓
Province FE		✓	✓		✓	✓
Pre-trend			✓			✓

This table presents the heterogeneity analysis results regarding whether the reduction effect of increased elderly welfare expenditure on the suicide rate varies by gender(Panel A), age(Panel B), educational attainment (Panel C), and household composition (Panel D). Model (1) and (4) include control variables constructed based on the pre-analysis period. Model (2) and (5) additionally control for provincial fixed effects, considering the potential variability in suicide rate across broader regions. Model (3) and (6) account for the pre-existing suicide rate trends from 2008 to 2011, aiming to address the potential for distinct trends in suicide rates during our analysis period. Heteroskedasticity-robust standard errors are shown in parentheses. Significant at the 10 percent level, ** Significant at the 5 percent level, and *** Significant at the 1 percent level.

Table 6: Placebo Test

	(1)	(2)	(3)	(4)
	Δ in Suicide Rates (Age⩾ 65, 2008 ∼ 2011)		Δ in Suicide Rates (Age 55-64, 2013 ∼ 2019)	
Δ in Welfare Expenditure (per capita)	-19.826**	5.861	-15.980*	1.640
	(9.866)	(23.788)	(9.308)	(19.725)
Observations	221	221	221	221
Controls	✓	✓	✓	✓
Province FE	✓	✓	✓	✓
Pre-trend	✓	✓	✓	✓

This table presents the placebo test outcomes. Columns (1) and (2) present the estimated results using the difference in elderly suicide rates from 2008 and 2011 as the dependent variable. Columns (3) and (4) shows the estimated results using the difference in suicide rates for the 55-64 age bracket from 2011 and 2019 as the dependent variable. Columns (1) and (3) provide OLS estimation outcomes without using an IV, whereas columns (2) and (4) present the results using our IV. Heteroskedasticity-robust standard errors are shown in parentheses. Significant at the 10 percent level, ** Significant at the 5 percent level, and *** Significant at the 1 percent level.

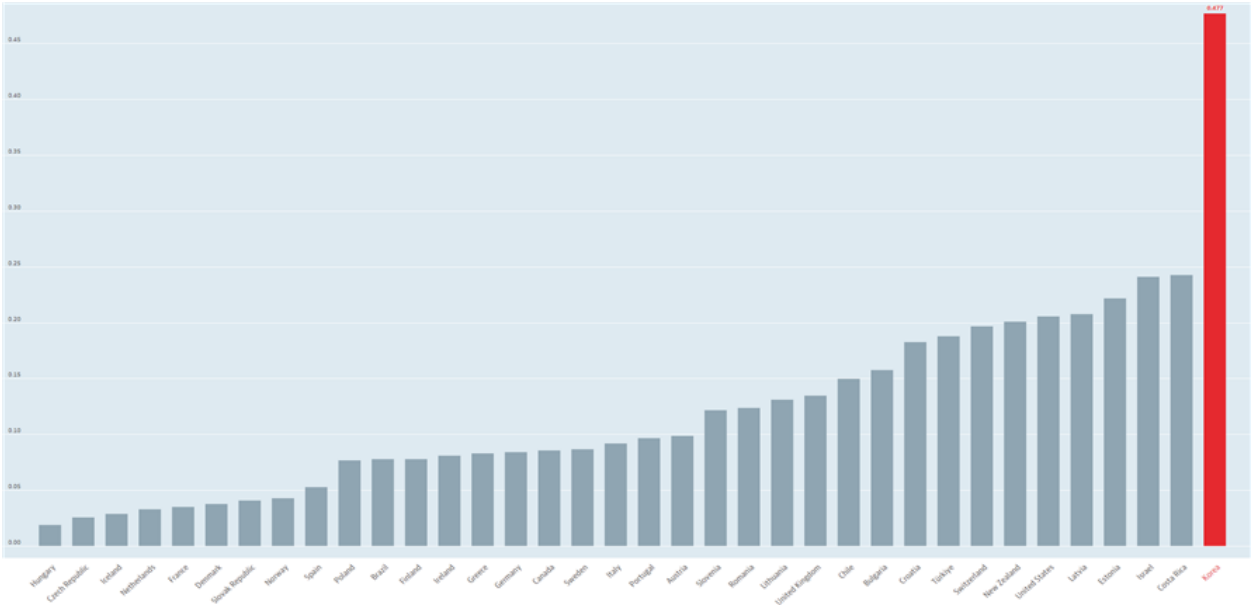
Table 7: The Effects of Basic Pension Reform on Elderly Income and Consumption (Compare Age 55∼64 vs Age 65+)

	(1) Public Transfer	(2) Private Transfer	(3) Total Transfer	(4) Labor Income	(5) Total Income
Panel A. Income					
Treat×Post	127.766***	-18.019 ***	109.747***	-190.856***	-3.214
	(15.021)	(6.699)	(15.934)	(55.831)	(79.661)
	(6) Food Spending	(7) Housing Spending	(8) Medical Spending	(9) Transportation Spending	(10) Total Spending
Panel B. Consumption					
Treat×Post	16.348*	6.863	12.120***	10.796**	57.258***
	(8.664)	(4.288)	(4.544)	(4.412)	(21.677)
Observations			40.441		

This table reports the estimated results based on Equation 3. The estimates capture the impact of the 2014 reform on the income and consumption of beneficiary households. Panel A offers results using income-related variables as dependent variables (public transfer, private transfer, total transfer, labor income, total income), and Panel B provides the estimated results using consumption-related variables as dependent variables (food spending, housing spending, medical spending, transportation spending, total spending). Standard errors are clustered at the family unit and shown in parentheses. Significant at the 10 percent level, ** Significant at the 5 percent level, and *** Significant at the 1 percent level.

Appendix Figures and Tables

Figure A1: Relative Poverty Rates in OECD Countries: Age 66 and over, Ratio, 2013



This figure presents the relative poverty rate (below 50% of median income) among elders (aged 66 and above) for OECD countries as of 2013. South Korea's elderly poverty rate (shown in red bar) stands at 47.7%, which is significantly higher when compared to the OECD's average poverty rate of 12.35%.

Table A1: Heterogeneous Effects (Age$\geqslant$ 80)

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Gender		Male			Female	
Δ in Welfare Expenditure	-138.765	-336.465***	-323.241***	-23.027	-40.718	-40.017
(per capita)	(114.819)	(119.686)	(114.295)	(55.666)	(49.765)	(49.003)
Observations	221	221	221	221	221	221
Panel B. Household Composition		Living Alone			Having other members	
Δ in Welfare Expenditure	-64.475	-223.783**	-207.516*	-50.155	-96.001	-90.086
(per capita)	(113.251)	(113.548)	(106.913)	(68.418)	(60.723)	(61.000)
Observations	221	221	219	221	221	219
Controls	✓	✓	✓	✓	✓	✓
Province FE		✓	✓		✓	✓
Pre-trend			✓			✓

This table displays the heterogeneity analysis results regarding whether the effect of increased elderly welfare expenditure on the suicide rate varies by gender(Panel A), and household composition (Panel B) for the 80 years and older. Model (1) and (4) include control variables constructed based on the pre-analysis period. Model (2) and (5) additionally control for provincial fixed effects, considering the potential variability in suicide rate across broader regions. Model (3) and (6) account for the pre-existing suicide rate trends from 2008 to 2011, aiming to address the potential for distinct trends in suicide rates during our analysis period. Heteroskedasticity-robust standard errors are shown in parentheses. Significant at the 10 percent level, ** Significant at the 5 percent level, and *** Significant at the 1 percent level.

Table A2: Predicted Basic Pension Receipt Rate by Household Characteristics

Variable	Value	Share	Predicted Receipt Rate
Highest Level of Education	No Formal Education	22.37%	92.34%
	Elementary School	33.13%	78.34%
	Middle School	15.09%	67.29%
	High School	17.34%	54.74%
	Bachelor's Degree or Higher	12.07%	27.40%
Age	65∼69	38.95%	58.62%
	70∼74	28.21%	69.87%
	75∼79	19.67%	80.25%
	80 and over	13.18%	85.34%
Number of Family Member	# of Member= 1	36.45%	90.02%
	# of Member= 2	48.13%	62.70%
	# of Member$\geqslant$ 3	15.42%	43.40%

This table displays the probability of a household receiving Basic Pension based on the educational attainment, age of the household head, and the number of household members. To calculate the probability of receiving benefits, we compute the household income used in the eligibility assessment for the Basic Pension, drawing from the Survey of Household Finances and Living Conditions (SHFLC) for 2012 and 2013.

Table A3: Summary Statistics: Survey of Household Finances and Living Conditions

Variables	Mean	SD	Min	Max
Panel A: Dependent Variables				
Public Transfer	450.30	772.42	0	8575.59
Private Transfer	131.21	303.73	0	7084.60
Total Transfer	581.51	816.77	0	8575.59
Labor Income	1581.41	2939.76	0	68374.00
Total Income	3340.15	4250.81	0	122013.80
Food Spending	242.60	389.46	0	5001.00
Housing Spending	121.18	192.78	0	5748.86
Medical Spending	80.23	224.13	0	9744.01
Transportation Spending	93.98	198.27	0	4680.00
Total Spending	641.60	1025.38	0	30240.87
Panel B: Explanatory Variables				
No Formal Education	0.12	0.32	0	1
Elementary School	0.26	0.44	0	1
Middle School	0.19	0.39	0	1
High School	0.26	0.44	0	1
Bachelor's Degree or Higher	0.17	0.38	0	1
Age	67.01	8.76	55	99
Number of Family Members	2.21	1.01	1	9

This table displays the summary statistics of our Survey of Household Finances and Living Conditions (SHFLC) sample. Panel A provides summary statistics related to dependent variables shown in Table 7 and Panel B presents summary statistics for the control variables.

Table A4: The Effects of Basic Pension Reform on Elderly Income and Consumption (Compare Age 55∼64 vs Age 65∼ 74)

Panel A. Income					
	(1) Public Transfer	(2) Private Transfer	(3) Total Transfer	(4) Labor Income	(5) Total Income
Treat×Post	142.350***	-7.379	134.971***	-144.635**	91.255
	(18.061)	(7.634)	(19.009)	(60.922)	(90.247)
Panel B. Consumption					
	(6) Food Spending	(7) Housing Spending	(8) Medical Spending	(9) Transportation Spending	(10) Total Spending
Treat×Post	16.400*	7.585	10.538**	10.324**	55.255**
	(9.778)	(4.844)	(5.177)	(4.868)	(23.915)
Observations	31,527				

This table reports the estimated results based on Equation 3. Unlike Table 7, where the treatment group includes all individuals over 65, here it is defined using ages 65-74, expected to be similar to the control group (ages 55-64). The estimates capture the impact of the 2014 reform on the income and consumption of beneficiary households Panel A offers results using income-related variables as dependent variables (public transfer, private transfer, total transfer, labor income, total income), and Panel B provides the estimated results using consumption-related variables as dependent variables (food spending, housing spending, medical spending, transportation spending, total spending). Standard errors are clustered at the family unit and shown in parentheses. Significant at the 10 percent level, ** Significant at the 5 percent level, and *** Significant at the 1 percent level.